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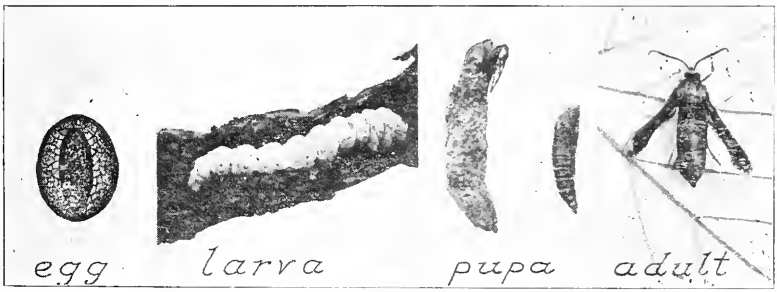
The Grapevine Root-Borer



BY FRED. E. BROOKS

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Grapevine root-borers, *Memythrus polistiformis*. Five borers were feeding on this section of grape-root when it was taken from the ground. Natural size. Photographed by W. E. Rumsey.

The Grapevine Root-Borer

Memythrus polistiformis HARRIS.

ORDER LEPIDOPTERA, FAMILY SESIIDÆ.

INTRODUCTION.

The grapevine root-borer has been recognized as an enemy of the grape in the United States for more than fifty years. It is quite widely distributed, having been observed as far north and west as Minnesota and Missouri, and south and east through Ohio, Kentucky, West Virginia and North Carolina.

Several writers upon economic entomology have given brief accounts of this insect, but it has not often attracted special attention, and has scarcely been accorded notice in several of the papers published relating to the insect enemies of the grape in the eastern states. It is capable, however, of doing serious damage to grapevines and the slight attention which it has received in the past is no doubt due in a measure to the obscure appearance and habits of the insect throughout the four stages that compose its life-cycle. So inconspicuous is the insect itself, and its manner of working, that a vineyard may be suffering greatly from its attacks and yet those who have the care of the vines remain entirely ignorant of the cause of the trouble. The eggs are small, of a dull color, and the female in ovipositing scatters them promiscuously about in the vicinity of the vines. The larvæ, or borers, feed beneath the ground on the roots of old vines, usually some distance out from the base of the roots. No chips or castings are thrown to the surface to direct attention to the injury which is being done. The roots of one-year-old and two-year-old vines are rarely attacked so that in the work of planting out vineyards the borer is not likely to be seen. The transformation from larva to adult takes place within an earth-covered

cocoon that is hidden in the ground, often six inches or more from the root where the borer fed. The adult moth flies by day, but in size, color and manner of flight it so closely resembles some of the common wasps of the genus Polistes that a close scrutiny is necessary in order to make sure that the insect under observation is a moth and not a wasp. As a result of these peculiarities the insect may be abundant in a locality and yet remain unnoticed by grape growers.

Vines when attacked by the borers do not often die as a direct result of the injury sustained, but may become so enfeebled that the annual growth of bearing wood is meager and the yield of fruit very small.

HISTORY.

The grapevine root-borer is a native species, and before the cultivation of grapes was engaged in here it no doubt fed exclusively, as it still does to some extent, upon the roots of wild grapevines.

The species was first named and described by Dr. Thaddeus W. Harris in 1854. (Report American Pomological Society, 1854, p. 10.) In 1867, Benj. D. Walsh devoted four pages of his First Report on the Noxious Insects of Illinois to a discussion of this species. He shows that at that time it was very destructive to grapevines in North Carolina and quotes as follows from a letter written by Mr. C. S. Jackson, of Danville, Kentucky, from whom he had received specimens of the borers and pieces of grapevine roots upon which they had been feeding: "Here in Central Kentucky I have noticed for a year or two past, spots throughout the vineyard suffering from decay; and where the vines are taken up and examined, this worm is found on almost every root." In the year 1871, C. V. Riley, (Third Report on the Noxious and Beneficial Insects of Missouri, pp. 75-77,) speaks of capturing the moths in Missouri and mentions the destructiveness of the borers throughout Kentucky. He also describes at some length the adult insect and the appearance and habits of the borers. Since the days of Walsh and Riley the species has been mentioned occasionally by other writers, but

the descriptions given by them have in most cases been drawn largely from the writings of these two entomologists.

RECENT OBSERVATIONS IN WEST VIRGINIA.

In the early spring of 1907, the writer, while transplanting some old Niagara grapevines in a small vineyard in Upshur County, found that the roots of the vines were being seriously injured by numerous, large borers. The borers were working beneath the outer bark of the roots and were of a whitish color and ranged in length from less than an inch to nearly two inches. This was the first time the insect had been noticed and soon after examinations were made of the roots of other vines growing nearby. The examinations showed that the attack extended to all the cultivated varieties growing in the vicinity, of which there were about thirty, and also to the wild fox grape, V. *labrusca*. In some cases as many as twenty-five borers were found in the roots of a single vine. The species was not at first recognized, and specimens were placed in alcohol and forwarded to Mr. A. L. Quaintance of the Bureau of Entomology, who identified them as being the larvæ of the grapevine root-borer moth. This moth belongs to the same family (Sesiidæ) as the common peach-tree borer, *Sanninoidea exitiosa* and squashvine borer, *Melittia ceto*. The full life-history of the species had never been worked out, and acting upon a suggestion from Mr. Quaintance, the writer devoted some time during the succeeding summer and fall to a study of the insect and its habits. The observations were all made in the vicinity of French Creek, West Virginia. On account of the difficulties connected with seeing the insect, no opportunity has been had of learning from personal observation as to its distribution and destructiveness in other sections of the state. It is probable, however, that it occurs in all localities where grapes are cultivated to any extent.

DESCRIPTION.

The grapevine root-borer belongs to a family of insects known as the clear-winged moths. The members of this family,

unlike most moths, fly only by day, and the different species usually bear a very striking resemblance to bees or wasps. The larvæ are borers, living within and feeding upon the woody tissues of plants of many kinds. Some of the other species of clear-winged moths that have attracted general attention on account of the injury which they do are the peach-tree borer, squashvine borer, currant borer and maple clear-wing.

THE LIFE-CYCLE.

The life-cycle of the grapevine root-borer is made up of four distinct stages, as is the case with all butterflies and moths: —namely, the egg, larva, pupa and adult. The writer has not yet observed a single individual moth pass through these four changes in their regular sequence, but the time required for the complete transformation from egg to adult is undoubtedly two years. Of this period, about twenty-one or twenty-two months is required by the larva. Riley states that this insect requires a year to develop, but in West Virginia, at least, the development certainly occupies a longer time. When the larvæ were first found in the early spring, and from that time on to the middle of June, they could very readily be separated as to size into two classes. Such a division showed a considerable difference in the average sizes of the two groups with no gradual gradation of the one into the other. By the middle of July those of the larger class had left the roots and pupated, while all the smaller individuals, so far as could be determined, remained feeding in the roots for the remainder of the season, and at this time, (November 1st,) are still unchanged except that they are now nearly full-grown. During the last half of July and the first half of August there was a period when borers of but one size could be found, but after the middle of the latter month the minute, newly-hatched specimens could be found feeding along with the larger ones that had hatched the previous summer.

The Egg and Oviposition. — The egg is oval in outline, slightly flattened at the sides, with one face evenly convex and the other marked by a deep longitudinal furrow, or grove. The length is slightly less than .04 inch, width .025 inch,

color chocolate brown, surface finely and densely punctured and marked with a network of delicate lines. Eggs are deposited by the female singly, or rarely in two, upon the leaves or stems of weeds, blades of grass, straws, or other low plants that may be growing or lying under or near grapevines, and sometimes upon the bark or leaves of the vines themselves.

Five females were observed in the vineyard while engaged in egg-laying. One of these was seen to deposit an egg upon the body of a grapevine about a foot above the ground and then walk along a branch of the vine for a distance of nearly ten feet, pausing on the way every few inches to lay an egg. About forty eggs were thus deposited on the bark of the vine. Another was seen to walk about over a dense bunch of grape foliage and leave 12 eggs upon the upper surface of the leaves. The usual practice of the females that were observed at egg-laying, however, was to fly low over the short grass and weeds that grew about the vines, pausing here and there in their flight only long enough to lay a single egg. They were seen to oviposit in this manner upon the leaves of grape, strawberry, ragweed, clover, cinquefoil, plantain, grass, and upon the stem of a dead weed and a straw. The eggs are but loosely attached to the objects upon which the moth places them, and a light wind or rain is sufficient to shake them to the ground, where they remain to hatch. The time required for hatching is about three weeks, as was shown by keeping a large number of eggs in a normal temperature in the laboratory. These eggs were obtained by confining two fertile females separately in glass jars, where they oviposited freely. The eggs thus laid hatched in from twenty-one to twenty-three days.

Something over 400 eggs are probably laid on an average by each female. One specimen that was dissected before she had begun ovipositing was found to contain 465 eggs. Most of these eggs were full sized and had a hard, brown shell, and it was not a difficult matter to count them. Another female was kept for six days in a glass jar, during which time she laid 391 eggs. On the sixth day she died and was found by dissection to still contain 11 eggs at the time of her death. This made a total of

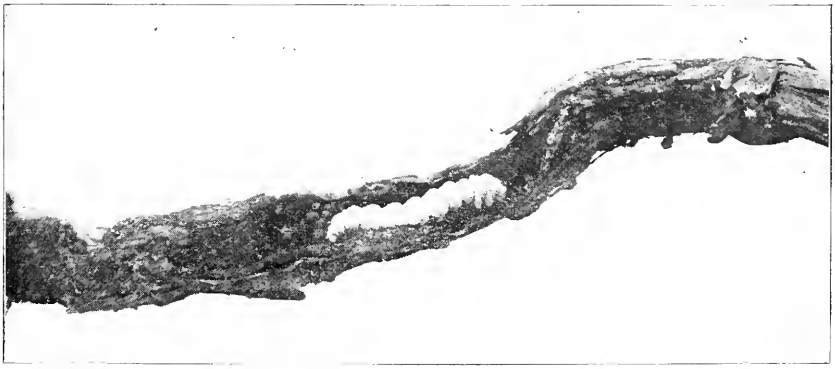
402. Still another kept in confinement laid 390 eggs, and then was allowed accidentally to escape.

THE LARVA. — It is in this stage alone that the insect is capable of doing any injury. When first hatched the larvæ are very small, being only about one twenty-fifth of an inch in length. They are whitish in color with brown heads, and are sparsely covered with stiff hairs. When full grown some specimens attain a length of one and three-fourth inches. As soon as the young borer is out of the egg, which, as stated, is on the ground at the time of hatching, it begins to work its way downward through the soil, evidently trusting good fortune to guide it to a grape root. That the borers can survive at this early age for several days with but little food was shown by placing half a dozen in a small bottle, where they lived for three days and then escaped by tunneling through the cork stopper. During the three days' confinement they had no nourishment except what they might have extracted from the dry cork, which was most likely very little.

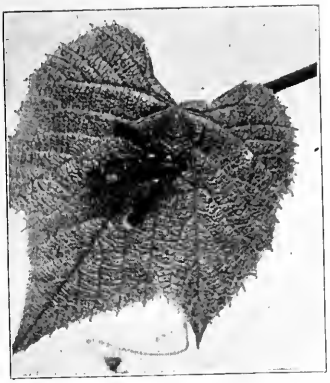
In order to note the method of the borers in penetrating the soil in search of their favorite food, some cuttings of grape roots were placed in the bottom of a box and four inches of fine earth pressed firmly down over them. On top of the earth was deposited a large number of newly hatched borers. The borers began at once to crawl about, and in fifteen minutes all had disappeared in the soil, having worked their way beneath the surface after moving but an inch or two from the point where they were first placed. A week later the cuttings were taken up and examined and were found to be thickly populated with the little borers.

The borer, after finding the root, first eats its way through the outer bark and then begins to excavate an irregular burrow, which at first is confined to the softer portions of the bark. At the beginning, this burrow may encircle the root several times, but later, as the borer increases in size, it is made to run with the grain of the wood and may be extended either toward or from the base of the root. The diameter of the burrow is increased with the growth of the borer until with roots a half-inch or

Male moth resting on grapevine near the ground soon after emerging from cocoon. About two-thirds natural size.



Borer feeding on grape-root.



A

B

C

D

E

A, female root-borer moth resting on leaf; B, egg of moth, greatly enlarged; C, stump of grape-root showing injury done by borers; D, pupa and cocoon, natural size; E, cocoons with empty pupa-cases protruding, reduced.

less in diameter, only the outer bark remains; all the inner bark and wood having been converted into frass. In larger roots the excavation will frequently reach to the heart and is most likely to be found extending along the under side of the root. As the borer advances in its feeding it packs the burrow behind full of its coarse, reddish-brown castings.

A large per cent. of the borers were found working in the roots a foot or more out from the vine. One was found that had apparently penetrated eleven inches of solid clay soil and had entered the root at a point nine feet from its base. This habit of the borer of feeding so far out on the root makes the process of extracting it with a knife and wire exceedingly difficult, but it also has the advantage of leaving a stump of sound root to help sustain the vine. Often a good-sized root will be found completely severed by the borers and at the wounded end of the stump a vigorous growth of young roots will be putting out. Such severe root pruning, however, greatly lessons the feeding area of the vine and weakens it correspondingly.

As has been stated, the larval stage probably extends over a period of twenty-one or twenty-two months. Feeding is believed to continue through the first winter, but the second winter is passed by the borer without food in a sort of cell, or hiberaculum, which it fashions out in the root and lines with a gauzy fabric of silk.

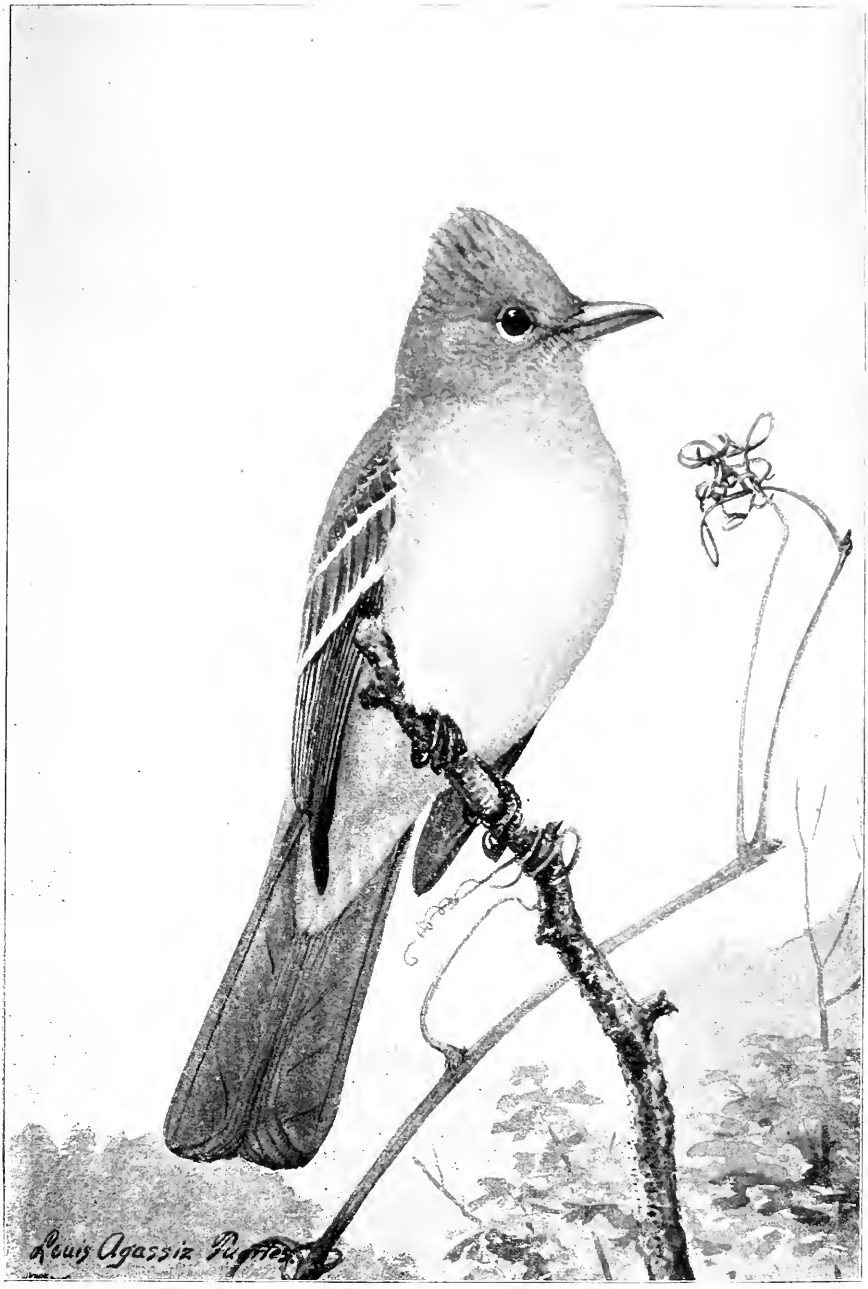
The Pupa. — When the larva is full grown and ready to pupate it leaves the root and ascends to near the surface of the ground. Here it constructs a rough, elongate cocoon, from three-fourths to one and one-fourth inches in length, which is composed outwardly of grains of earth and excrement and lined with tough silk. Within this cocoon it transforms to a pupa of dark brown color with yellow bands encircling the abdomen. The cocoon stands perpendicularly in the ground, with the upper or head end just beneath the surface. When about to emerge the moth works half the length of its pupa-case out of the cocoon and then escapes from the case through a slit in the back. The discarded case is left with one end adhering in the cocoon and the other projecting above the ground.

The duration of this stage was not determined exactly for any one individual. Two cocoons were found in the ground, however, on June twenty-second and on July twenty-fourth a male emerged from one and six days later a female from the other Judging from the fresh appearance of the cocoons at the time they were found, and from the fact that most of the full-grown larvæ were yet in the roots, it seemed safe to assume that they were but recently formed and that the pupa stage, therefore, covers a period of four or five weeks.

THE ADULT. — The mature insect is a handsome moth, the sexes of which differ considerably in size. The males vary from five-eights of an inch to three-fourths of an inch in length, and from one inch to one and three-eights inches in expanse. The females are larger, measuring about seven-eights of an inch in length and one and one-half inches in expanse.

The general color of both sexes is a dark, lustrous brown. The fore-wings are brown and the hind-wings transparent, bordered and ribbed with brown. The abdomen is encircled at the posterior margins of the second and fourth segments with bands composed of orange and lemon-yellow scales intermingled, the lemon-colored scales predominating in the front band and the orange in the other. There are also spots of similar colored scales on the thorax at the base of the wings. As the moths grow old and worn with flight these markings are likely to disappear to some extent. The legs are reddish-brown, the antennæ of the males brown, marked with metalic colors and those of the female metalic purple and bronze. The antennæ of the males are delicately pectinate, or fringed. The female has a little orange-colored tuft on each side of the tail, and the male has two tufts on each side, the middle pair being longer than the others.

Moths were first seen on the wing on July 24th, and for about fifteen days thereafter they were abundant. Often a dozen or more might be seen at one time flying rapidly about the vines or resting quietly for long periods upon the leaves of grapevines or of other plants growing nearby. By the tenth of July the moths were disappearing, and although daily watch was contin-



Crested Flycatcher, *Myiarchus crinitus*. These birds were found feeding on the root-borer moths in a vineyard in Upshur county.

Male and female root-borer moths on a wild lettuce leaf under a grapevine. About two-thirds natural size.

ued for six weeks, only one was seen after the fifteenth of that month. This was a male that was caught in the vineyard on August 25th. The males made their appearance a few days in advance of the females and throughout the period of their flight were much more abundant than those of the other sex.

Walsh states that according to Dr. F. J. Kron, of Albemarle, North Carolina, the moths are on the wing in that state from the middle of June to the middle of September. This does not agree with the writer's observation in West Virginia, as nothing was seen here to indicate that they were flying for a period of more than four or five weeks, although a close watch was kept throughout the season of the changes taking place in the larvæ and pupæ, as well as of the moths themselves.

As previously stated, there is a close resemblance between these moths and some of the common wasps of the genus Polistes. The flight of the female before her eggs are laid is a little heavy and less rapid than that of a wasp, but the movements of the male on the wing are quick and wasp-like, and have no conspicuous peculiarities by which they may be distinguished from those of a wasp.

The moths of either sex will very frequently alight upon the upper surface of a grape-leaf or in some other exposed position, and remain for an hour or more without motion, except an occasional fluttering of the wings like an angry wasp. This movement is accompanied by a low, buzzing sound, which, taken together with the formidable appearance of the insect at the time, makes one hesitate to approach too near, even though he may know that the act is but a clever bit of mimicry.

In the several cases observed the moths emerged from the cocoons in the forenoon. After remaining near the cocoon for a brief time to allow the wings to harden, the males would fly away, but the females would crawl to an exposed position near and await the coming of the male. In the four cases that were watched, copulation took place during the afternoon following the emergence of the female, and egg-laying began the next morning. Oviposition is carried on only during the warmer part of the day, usually between 9 a. m. and 4 p. m., and about

a week is probably required by a female for laying her full quota of eggs. The life of a moth of either sex is not likely to exceed ten days or two weeks.

NATURAL ENEMIES.

Birds. — One of the vineyards in which the studies of the root-borer were carried on extended along the side of an orchard of pear trees. These trees, at the time the moths were flying, seemed to be a favorite resort for a family of crested flycatchers, *Myiarchus crinitus,* and several times the birds were seen hawking among the grapevines. On the morning of August 1st, one of the flycatchers was observed to leave the top of a pear tree, catch some insect that was flying near the grapevines, and then return to the tree. This procedure was repeated several times when the bird was shot and an examination made to ascertain what insects it had been catching. The bird proved to be a young female, and the stomach contained seven of the root-borer moths and one large grasshopper, all of which had been but recently swallowed. Two of the moths were females, and these two contained 416 eggs which could be counted. If this one examination indicated anything like the extent to which these flycatchers were feeding on the moths, then the birds must be, in that locality at least, a very important factor in reducing the number of borers. The seven moths had supplied only a breakfast for the bird, and if the same rate of feeding were kept up for a day by the five or six flycatchers that frequented the vicinity of the vineyard, not less than a hundred moths would be consumed. It can therefore be seen that any condition favoring the presence of these, as well as other insectivorous birds, about a vineyard is greatly to be desired. Kingbirds, *Tyrannis tyrannis,* were seen feeding about the vines several times, but no positive evidence was obtained that they were catching the moths.

Fireflies. — One other very interesting natural enemy of the root-borer was noticed. This was a larva of one of our common fireflies, or "lightning-bugs," *Photuris pennsylvanica,* which had gained entrance to a moth cocoon and was devouring

the pupa when found. Several of these larvæ were noticed in the ground about borer infested grapevines and peach trees, but only the one was seen engaged in taking food.

METHODS OF CONTROL.

This borer will prove one of the most difficult of its class to combat. The methods that are in common use against such pests as the apple-tree borers and the peach-tree borer are, in many cases, almost or entirely useless with this species. Wire netting, or paper or wood-veneer wrappers, which are often placed around the bodies of fruit trees to prevent the parent borer from depositing her eggs on the bark, are of no value here, for the reason that this species does not often oviposit on the bark. For a similar reason no relief can be had from using poison or repellent washes such as are sometimes applied to the trunks of trees to prevent the young borers from entering the wood. Even digging out these borers with a knife and wire is impracticable on account of the quantity of earth which it is necessary to remove in order to get at the infested roots. This digging out process might be resorted to with vines that for special reasons are valued very highly, but the amount of labor that it would involve in a large vineyard would render the undertaking out of the question. If digging out is resorted to, the work may best be done in October or November. At this season the soil is likely to be in good condition to handle and the young borers that have hatched the previous summer will have attained size enough to make their discovery an easy matter when once the root is uncovered.

Immune Varieties. — According to Walsh and Riley the roots of the Scuppernong, or southern, wild fox grape, are never attacked by this borer. Unfortunately, no such claim can be made for our northern fox grape, for its roots were found to be no less subject to attack in the vineyard at French Creek than those of Concord, Niagara, Catawba and other cultivated sorts. If it be true that the roots of the Scuppernong are never attacked, in localities where it will thrive, its roots might be

grafted with more valuable sorts and freedom from the borers obtained. The Scuppernong grows wild in a few localities of West Virginia, but would not be likely to do well in the colder sections of the state, and therefore this method cannot be recommended for general use here.

Killing the Moths. — The females, when they are engaged in egg-laying, can very readily be approached and killed by striking them down with a paddle-like instrument or board. If a watch is kept about infested vines from the middle of July to the middle of August the females may be seen and killed in this way.

Cultivation. — It is by the thorough cultivation of vineyards that the greatest good is likely to be accomplished in the way of reducing the ravages of this insect. Observation has shown that from the middle of June to the last of July the insects are transforming from the borer stage to the adult stage within cocoons which, are located just beneath the surface of the ground in near proximity to grapevines. If, during this period the ground about the vines is thoroughly cultivated, most of these cocoons will be either thrown to the surface where the pupæ within will perish, or be buried so deeply that the moths escaping later will not be able to work their way out of the soil. The cocoons are usually found a foot or more away from the vines, a fact that enables the cultivator to reach most of them without the necessity of working up entirely to the vine, which is a difficult thing to do where some methods of pruning are practiced. As a matter of course, the cultivation will give the vines increased vigor, enabling them more readily to withstand and overcome the attacks of root-borers and other insects.